thought of applying it to the extremely important case of stellar motion in the line of sight. Huggins was the first to do this, in 1868, with a new instrument, the result of some years of consideration.

The fertility of this new method, the beautiful and unexpected results which it has given in later years, is well known, and there is no doubt that in the future it will be the means of revealing to us much that at the present time remains mysterious.

At about the same time Huggins had tried to observe the prominences of the sun in the absence of an eclipse. He solved the problem and published an account of his methods, so that although he was preceded in the observation itself by Janssen and Lockyer, his high reputation was sustained. Immediately afterwards we find, as his contribution to the development of the subject, a description of a method for not only determining the chemical constitution, but also the actual shape of the protuberances.

In still another region Huggins has been a pioneer. As early as 1864 he had tried to photograph star spectra, but with his small and imperfect apparatus he only obtained spectra without lines. He did not, however, lose sight of the problem, and after the invention of dry plates he constructed a spectrograph out of rock crystal and Iceland spar which, with a Cassegrain telescope, gave the well-known beautiful spectra, among the novelties of which may be mentioned the revelation for the first time of the ultra-violet series of hydrogen.

The continued application of photography to the spectra of the various celestial bodies, the discovery of innumerable important and interesting results, occupy the following decades of a laborious life. It is impossible to follow in detail the whole of Huggins' achievements, contained as they are in nearly a hundred publications. To do so would require volumes, not one short article; nor is it possible to point out how Huggins was enabled by the construction of his spectroscopes to produce those excellent photographs which have excited our admiration during the last twenty years. There does not exist, I believe, any stellar spectrograph which does not involve in its construction ideas taken from Huggins' models. One obtains a superficial insight into the immense progress made by Huggins in the photography of stellar spectra in the book which he has presented to science under the title "Atlas of Representative Stellar Spectra," by Sir William and Lady Huggins. This and all the later publications of Sir William Huggins are signed also by Lady Huggins, in whom Sir William has found an "able and enthusiastic assistant." It would therefore be unjust not to mention Lady Huggins in a description of Sir William's work.

This necessarily very short and incomplete review, in which only a few of the most important discoveries could receive mention, while many others, such as, for instance, the detection of the band spectrum of water-vapour, had to be passed over, will show how productive and beneficent to science his life has been. The child to whom he gave life, Astrophysics, has been the object of his care and attention and has now developed into a strong and beautiful man.

The father can look with pride upon his child, and well may he be happy to see the progress which has been made and the number who now devote their energy and knowledge to this part of science.

But above all Huggins is distinguished by the extraordinary accuracy of all his publications. He has always been very cautious in drawing conclusions from observations; with an enthusiastic heart he has combined a cool head. He has scarcely ever been forced to retract or modify a statement, and therefore his views are universally accepted and his authority remains unrivalled, which I think to be the highest reward and greatest honour to which a scientific man can attain.

William Huggins was born in London, 1824. He built his private observatory in 1856, became President of the Royal Astronomical Society, 1876; President of the British Association, 1891; President of the Royal Society, 1900. He has received a Royal medal, the Rumford medal and the Copley medal from the Royal Society, and two medals from the Royal Astronomical Society. He married Miss Margaret Murray, of Dublin, in 1875. H. KAYSER.

ENGLAND'S NEGLECT OF SCIENCE.

England's Neglect of Science. By Prof. Perry, F.R.S. Pp. 113. (London: T. Fisher Unwin, 1900.) Price 2*s.* 6*d.*

UNDER the above title Prof. Perry publishes a collection of seven short papers dealing with several questions relating to the position of science and the method of teaching it in England. The little book itself takes its title from the second of these papers, an article which appeared in NATURE in July 1900.

The subject is one of such great magnitude and intricacy that it is scarcely possible for a private individual to bring a sufficient knowledge of details to bear upon it. Nothing short of a commission of men of science would suffice to collect the mass of statistics which is necessary for the complete discussion of the shortcomings of England in her relation to scientific education. We must, therefore, be content to deal with it from a few points of view only, most of these being indicated by Prof. Perry himself.

Prof. Perry is well known to be, like several of his colleagues in science, dissatisfied with the position of science in England, with its influence in the affairs of State, and with the provision made for its support and development. When, however, he speaks of "England's" neglect of science it would be well if he made a distinction between England as a *nation* and England as a *Government*. It is not true that the English people as a whole are indifferent to the supreme claims of science in the modern world, but it is most unfortunately true that the men placed by the people at the heads of the Government departments are sadly wanting in a knowledge of science, and are, as a result, almost indifferent to its interests. Indeed, at the hands of the typical English Government official the profession of scientific education shares with science itself the results of this indifference. There is unquestionably a marked want of sympathy on the part of our Government officials with all those whose business it is to spread scientific knowledge among the people. What is the cause of this? The simple and direct answer is—the public schools. These institutions—some of them venerable as to age, all of them venerable as to ideas—supply almost exclusively the professional politicians to whose care the interests of the great departments of the Government are committed, and in all of them the dominant educational ideals are classical and mediæval. The career of the English professional politician is fairly well stereotyped. A classical education at one of the fashionable public schools, followed by something very similar at an ancient University, accompanied probably by the pursuit of some branch of athletics, and almost certainly by a continuous neglect of all branches of science, is the typical training of the heads of English officialdom. Neither science nor those whose profession is the teaching of science can hope for much encouragement from rulers developed by such a system as this. As for zeal in the promotion of invention or discovery before the thing aimed at becomes a visible and established fact, let no man look to an English Government department for that.

If the root of the public evil—England's *official* neglect of science—is to be found in the mediævalism of the public schools, the cause of the evil in the schools themselves is, to a great extent, to be sought in the *classical clerics* who are almost invariably placed over them; for very few of the head masters are men who have received any training in modern science. It is doubtful, however, if this is the *whole* cause of the unscientific character of the public schools; for in most, if not in all, of them some science is taught, and in several there are to be found laboratories erected at a cost of many thousands of pounds. But the "modern side" does not rank high in the estimation of the public school, and science is dignified with the name of "stinks." Modern science seems to fit the English public school about as well as a new piece fits an old garment; and if a knowledge of science is a desirable and important thing in the upper classes of this country, the whole system of the public schools must be overhauled.

Prof. Perry himself says some plain words on this matter (p. 14):—

> "Much of the evil we suffer from is due to our average young men being pitchforked into works where they get no instruction, as soon as they leave school. If ordinary school education were worth the name, and if schoolmasters can be brought to see that we do not live in the fifteenth century, if boys were really taught to think for themselves through common sense training in natural science, things would not be so bad. But the average boy leaves an English school with no power to think for himself, and with less than no knowledge of natural science, and he learns what is called mathematics in such a fashion that he hates the sight of a mathematical expression all his life after."

It is most true, as Prof. Perry said recently in a lecture to working men at South Kensington, that, under our present unscientific educational system, "the most prominent Englishmen understand nothing of those sciences which are transforming all the conditions of civilisation."

But it is sometimes said in reply to those who complain of the want of scientific knowledge and sympathy on the part of the heads of Government departments, "you must remember that the real managers of these departments are not the heads but the permanent subordinate officials." This may be so, but it is very doubtful if we are any better off in the hands of these permanent officials. The higher appointments of the Home Civil Service are now filled by candidates selected from those who have successfully passed the examination for the Indian Civil Service; and an investigation will show that about 80 per cent. of the successful candidates obtain their places by means of classics; thus the chances of an infusion of scientific thought into the Government offices are not great.

It is vain to say, as some of our politicians are fond of telling us, that England must depend for the encouragement of science upon private benefactions and not upon Government support; a Government which adopts such a principle is simply shirking one of the greatest of its obligations.

A striking illustration of the unsympathetic attitude of English Governments towards men of science, and more especially the teachers of science, is always furnished by a perusal of the "New Year" and "Birthday" list of honours. Peerages and baronetcies are given somewhat freely to brewers and political supporters, and a perfect shower of knighthoods and minor honours to a host of officials of whose achievements the nation in general is profoundly ignorant. Now and then a Kelvin, a Lister, or a Stokes appears; but, though England possesses scientific inventors and discoverers in large numbers, very few of them are thought] worthy of national recognition.

Setting aside the radical weakness of our school system—its mediævalism—there are some defects that are more easily rectified; and among these Prof. Perry specially emphasises the orthodox procedure in the teaching of mathematics. Nothing but the ingrained conservatism of the English people would continue to base a boy's first knowledge of geometry on the peculiar language and the abstract reasoning of Euclid. Euclid, as has been repeatedly and vainly pointed out, was never written for boys; Euclid is difficult and not particularly well ordered; but Euclid is *classical*, and therefore Euclid is acceptable to the public schools, notwithstanding the fact that most boys waste years in attempting to acquire the somewhat grotesque language in which Euclidean logic is couched without attaining a real knowledge of even the nature of *an angle!* To know how Euclid shapes in the minds of the majority of schoolboys, to understand what a keen logical sense and expression they acquire from it by years of practice, one must conduct a public examination in the subject—and then not despair of the human race.

Prof. Perry does not confine his attack on our system of teaching mathematics to Euclid; he holds that a boy's scientific knowledge, generally, should not be primarily based upon abstract reasoning.

> "Why not let a boy jump over all the Euclidean philosophy of geometry and assume even the 47th proposition to be true? Why not let him replace the second and fifth books of Euclid by a page of simple algebra . . . ?"

Some such procedure as Prof. Perry here indicates is really the key to improvement in our scientific teaching; and the objections which his proposal is likely to meet are met by him with a certain forcible humour:

> "Because the embryo passes through all the stages of development of its ancestors, a boy in the nineteenth century must be taught according to all the systems ever in use and in the same order of time. Think of compelling emigrants to pass to America through Cuba, because Cuba was discovered first. Think of making boys learn Latin and Greek before they can write English, because Latin and Greek were the only languages in which there was a literature known to Englishmen 450 years ago!"

And this is, substantially, our procedure. Prof. Perry's remedy for our waste of time in mathematical teaching is contained in his advocacy of what he calls "Practical Mathematics," which may be described as a short cut to all the most important results and methods of science without the preliminary passage through a train of abstract reasoning in the old order—not, we presume, that the abstract reasoning is to be abolished altogether, but that it will come later and more easily when the results which it was originally employed to establish have become familiar practical truths by experience and measurement. This contention of Prof. Perry's does not, of course, agree with the pure *a priori* nature of mathematical reasoning hitherto accepted as orthodox truth. Indeed, it is not uncommon to hear even some scientific men objecting to such a principle as Prof. Perry's in some such terms as these: "Mathematics is primarily an education of the mind, and it must be regarded as an end in itself; the object of education is not the short and rapid attainment of practically useful knowledge, but the *cultivation of thought*." The simple answer to this is that, in view of the pressure of competition in the affairs of practical science, we cannot afford to take things in the old leisurely manner. Moreover, as already said, the re-ordering of our mathematical teaching according to the plan sketched by Prof. Perry in his chapter on "Practical Mathematics" does not involve, by any means, the *abolition* of abstract reasoning, but the *postponement* of it until the mind of the pupil is in the best condition to employ it.

We cannot afford space to discuss Prof. Perry's syllabus of practical mathematics in detail, but we may say that all those who have either the good fortune or the bad, according to the scene of their labours, to be employed in the teaching of mathematics, will find their work facilitated by adopting the system of graphic representation and graphic solutions so strongly advocated by Prof. Perry. The graphic method of solution of problems otherwise insoluble constitutes a wonderful interest both for the pupil and for the teacher; but, unfortunately, this fact is as yet very imperfectly recognised.

There is one branch of the question of school teaching which is scarcely noticed by Prof. Perry—the question of the preparatory school. The growth of the preparatory school in England within the last twenty years is most remarkable. This somewhat costly institution is, as a rule, an exact copy of the public school. The methods, the language, and, above all, the athletic ideals and aims of both are the same. The unscientific career in the greater institution is carefully initiated and cultivated in the less. Now, although nearly every branch of physical science is full of facts, principles and methods, the experimental illustration of which would awaken a far greater interest in the mind of a young boy than can be awakened by Greek or Latin grammar, the teaching of the elements of physical science in the preparatory stage of youth is almost unknown. There is a great deal of the elementary, but very important, portion of the science of electricity which every boy of the age of twelve (or less) should know, and could learn with no difficulty whatever; but he is kept rigorously aloof from all such knowledge, and we see him at the age of thirteen or fourteen fully equipped at his preparatory school for his public school exhibition or scholarship, absolutely ignorant of every electrical fact in existence.

This refers, of course, to boys of the better classes—those who look forward to a public school education. Prof. Perry remarks on the subject (p. 95):—

> "I see no reason why the principles of physics should not be intimately known to every child who has passed the age of twelve years. . . . An examination of the work carried on in the model national schools in Ireland will show that in many cases children of eleven and twelve years possess a fair knowledge of physics and chemistry, and when they do not possess this knowledge it will be found that too much attention has been paid to Euclid and grammar, and perhaps practical geometry has not been studied at all."

In taking leave of Prof. Perry's suggestive little book, we would say that if the average English parent is content that his son should be brought up according to the classical model of the public school, with its athletic ideals and that superior "tone" with which it is generally credited, it might not be proper for any one to interfere with his choice; but when we reflect that these classical institutions are those in which our political rulers acquire their training and form their ideals, without appreciable modification by a subsequent career in an old University, the whole nation has a right to complain. The professional politician is apt to look down upon the professors of science; and until science makes its presence felt in the Government of the country by having eminent scientific men in its councils, we shall have to continue to deplore "England's neglect of science."

GEORGE M. MINCHIN.

GRANT DUFF'S NOTES FROM A DIARY.

Notes from a Diary, 1889–1891. By Sir Mountstuart E. Grant Duff. Vol. i. Pp. viii + 287. Vol. ii. Pp. 272. (London: Murray, 1901.) Price 18*s*.

IT might truly be said of Sir Mountstuart Grant Duff as was once said of Van Dyck, "During these years all noble England passed before him and remained immortal." He is a member of the best clubs—the